

TYPES OF METAPHOR IN CIVIL ENGINEERING COMMUNICATION

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ABSTRACT. *Metaphor and other imaginative mechanisms that underlie human thought and language such as metonymy are used in everyday and specialised discourse (Lakoff and Johnson 1980; Lakoff and Nuñez 2000) They can also be involved in non-verbal forms of communication (Forceville and Urios-Aparisi 2009; Littlemore et al. this volume). Drawing on metaphor cognitive studies and on conceptual integration theory (Fauconnier 1997; Fauconnier and Turner 2002) this paper examines the occurrence of metaphor in engineering. First, we analyse results from a linguistic corpus formed by research papers from civil engineering journals. These data reveal the use of anthropomorphic metaphor, especially related to health or medical mappings such as “diagnosing”, “auscultation” or “curing”. Then, we explore how engineering notions are instantiated by bodily conceptual mappings according to conceptual integration theory. Finally, the function of visual metaphor is examined with conceptual integration theory by using engineering images evoking parts of human or animal anatomy.*

KEY WORDS. *Cognitive linguistics and LSP, meaning construction, conceptual integration, engineering metaphor.*

RESUMEN. *La metáfora y otros mecanismos imaginativos subyacentes al pensamiento y lenguaje humanos pueden ser utilizados en el discurso diario y especializado (Lakoff y Johnson 1980; Lakoff y Nuñez 2000). Asimismo pueden aparecer en la comunicación no verbal (Forceville y Urios-Aparisi 2009; Littlemore et al. este volumen). Partiendo de estudios cognitivos y de la teoría de integración conceptual (Fauconnier 1997; Fauconnier y Turner 2002), este artículo examina la presencia de la metáfora en la ingeniería. Primeramente, se analiza un corpus lingüístico procedente de artículos de investigación de ingeniería civil. Los datos revelan el uso de la metáfora antropomórfica, sobre todo en expresiones relativas a la salud, como “diagnóstico”, “auscultación” o “proceso de curación”. Se exploran además ejemplos de ingeniería cuya fuente son proyecciones conceptuales corporales. Finalmente, abordamos la función de la metáfora visual bajo la teoría de integración conceptual mediante representaciones de ingeniería que evocan la anatomía humana o animal.*

PALABRAS CLAVE. *Lingüística cognitiva y LFE, construcción del significado, integración conceptual, metáfora en la ingeniería.*

1. INTRODUCTION

Within civil engineering discourse, some noteworthy linguistic features are found. For example, a considerable number of expressions appear to be borrowed from the health/therapeutic domain. This domain apparently unrelated to engineering, not only does serve as a conceptual source, but also interacts with the target domain constructing meaning and thus providing an emergent structure. Data to corroborate this were obtained from linguistic evidence from written (books, journals, manuals) as well as spoken (engineers' interviews and lecturing) material.

In this respect, books and academic subjects that deal with the "*pathology*" of engineering structures are fairly common in this field and websites named "*Building or Construction Pathology*" can be easily found on the Internet. Similarly, engineering activities could involve the use of *auscultation devices* for dams and other building structures, and *bleeding* is an (undesirable) effect that may occur in different types of concrete. Equally, metal beams could have *fissures* and thus be affected by *stress* and *fatigue*. Data such as these appear to confirm that medical or therapeutic metaphoric mappings are so common in civil engineering that in engineering their use has become entrenched and conventional.

The next step will be to clarify the reasons why specific mappings and metaphors seem to be salient and common in two languages, English and Spanish. According to Fauconnier's (1999) words: "Language is only the tip of a spectacular cognitive iceberg".

Typically, a civil engineer's job includes the design of large (often public) structures and also involves solving problems that may affect these structures. For example, engineers are concerned with how to save transportation obstacles, such as a river, with the construction of a suitable bridge, or with how to link two distant towns by means of a highway. Bridge construction must meet standard criteria and fulfil technical conditions such as the ability to withstand opposing forces and to bear various types of loads over its deck. On the other hand, any bridge is situated at a specific location and surrounded by a unique environment. It is not the same to build a road bridge as one across a bay. One way to deal with the complex and sophisticated techniques involved in bridge construction is to treat bridges as living beings, i.e. using the anthropomorphic metaphor, and viewing them as having a lifespan and a type of behaviour/performance similar to living beings. Therefore, bridges should be *monitored* and their physical condition tracked through convenient technical methods. Accordingly, bridges' *state* should be regularly checked to avoid major mishaps such as *collapse* that could be due to *fatigue*, *decay*, *aging* or *stress*. This repertoire substantiates the anthropomorphic metaphor, which is posited as an overarching metaphor in engineering.

The medical metaphor occurs conventionally in engineering and its use is similar to idioms in general language. For instance, if someone advises us not to "throw in the towel", we do not actually think of a towel, or a fight in a boxing ring. Instead, we understand that we are being encouraged to endure some sort of hardship in life. In the same way, during their practice, engineers do not have to be aware of the borrowed

mappings they engage. They just make use of them automatically, since this language was previously assimilated during their training. When in use, these expressions help them to communicate and to understand their community discourse.

It is true, on the other hand, that the medical and the engineering jobs could share certain characteristics, including a similar pragmatic approach to their jobs. In today's world, engineers have to deal with uncertainties and risks, so they need to apply probabilistic theories and consider a lot of variables when taking decisions. Both engineers and doctors know that they depend on gathering contextual and perceptual information from technical tools and machines (Blockley 2005: vii-viii). In Calatrava's words, engineers are concerned with the "empiric, the experimental understanding of the reality" (BBC interview quoted in the references). Like doctors, civil engineers are held responsible of people's lives when building dams, bridges, tunnels, etc. Similarly, the engineering job includes learning from errors. For example, the Tacoma Narrows bridge collapse in the Washington State USA remains a prototypical case study for engineers on why suspension bridges may fail and provoke human casualties. Therefore, examples like this are exhaustively studied by engineers by means of laboratory or field analyses or by performing "autopsies of defunct constructions" (quoted from the "Pathology Construction" website). The engineer's goal is to prevent major catastrophes affecting human lives.

The main aim of this paper is to focus on the use of therapeutic/medical language as a major input for expressing civil engineering concepts. Conversely, it is not unusual to find cases of engineering expressions used as source domains to convey general ideas like in *cementing a friendship*; also in colloquial English *hitting/going through the roof* (getting furious); or in the expression *glass ceiling*. Some uses may also target the health domain, as in colloquial Spanish: *estar para el desguace*, literally: 'to be ready to be taken to the scrapyard' but actually meaning: 'to feel shattered or in a terrible condition'. These uses, however, would fall out of the scope of the present study.

The conceptual integration (blending) framework proposed by Fauconnier (1997) and developed in Fauconnier and Turner (2002) has been followed in this paper. The conceptual integration stance encompasses conceptual packets and image metaphor, blends, categorizations, frames, counterfactuals and metonymies. Cases of therapeutic blends in engineering are shown along with examples illustrating the importance of perception and visual representations in engineering. This includes "image blends" and visual metaphors that will be examined below.

2. CORPUS RESULTS AND IMPLICATIONS

The preliminary phase of this study deals with the results of a corpus of engineering keywords and their main collocations (Roldán and Protasenia 2007). The corpus consisted of 81 journal articles of *Revista de Obras Públicas*, the official professional journal for Spanish chartered civil engineers ("Ingenieros de Canales, Caminos y Puertos"). Most of the papers are written in Spanish, although 20% are in English, comprising from January 2000 to December 2005. Concordances,

frequencies, clusters and keywords were subsequently extracted and analysed by means of AntConc 2006 software and by applying the OU CREET (Metaphor Network) procedure for metaphor analysis in discourse. Other corpus approaches to identify metaphor such as those by Charteris-Black (2004), Caballero (2003a, 2003b), and Deignan (2005) were used as references. On the other hand, for a thorough comparison of the Spanish corpus with English counterpart expressions, the *New Civil Engineering Dictionary* (2005) was used and in order to check linguistic salience and academic impact, Imperial College (UK) civil engineering academic syllabuses and course books were scrutinized. From the total number of word tokens obtained (over 50000), nouns were mainly considered, since articles, prepositions, and auxiliary verbs are not likely to show the presence of metaphorical mappings. For the same reason, adjectives or adverbs were discarded. The total number of nouns analysed amounts to 1683. This civil engineering corpus suggests that a considerable number of hits show an anthropomorphic source. Interestingly, the highest frequency of tokens (figure 1) corresponds to *control*, and a close examination of its concordances (figure 2) suggests that its meaning could be equivalent to the meaning of *monitoring* (Patjawit and Kanok-Nukulchai 2005).

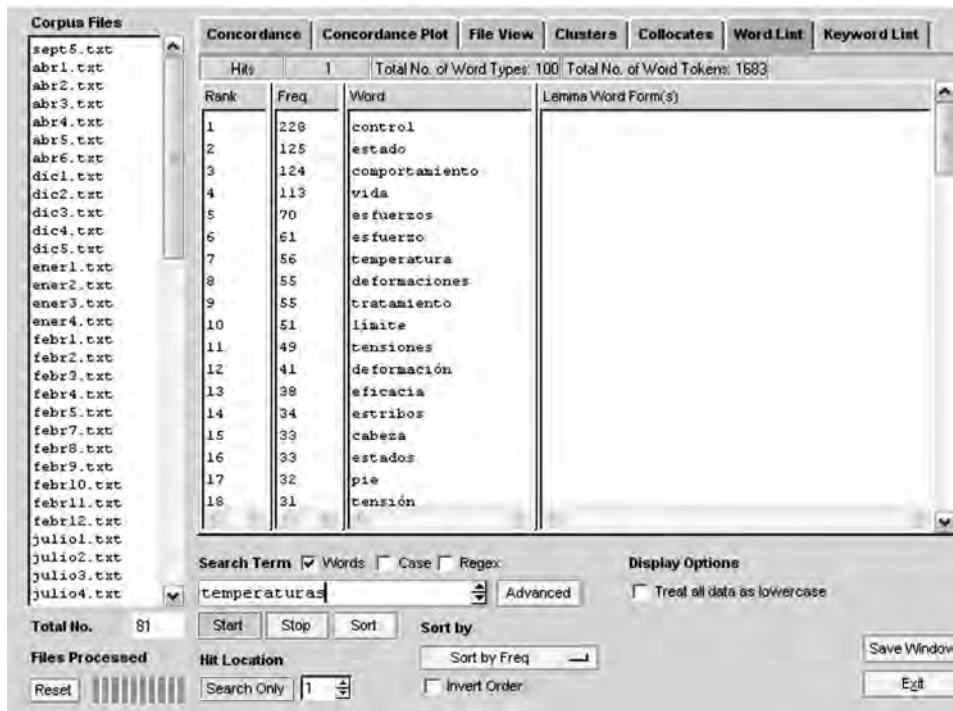


Figure 1. Frequency of noun tokens.

In fact, the engineer must test the soil to prevent landslides or other soil problems through subsequent surveys of a structure, as shown in concordance examples of figure 2. Counterpart mappings in the therapeutic/medical domain would be about checking (monitoring) a patient to prevent or cure an injury or illness. This correlation puts forward the role of embodiment mappings as a source domain, and as we will see below, embodiment is also inherent to other cognitive operations such as counterfactuals, metonymy, frames or categorizations. Consequently, given the specifics of conceptual and perceptual mappings typical of engineering, mental spaces and blending theory seems to be an appropriate framework for this study.

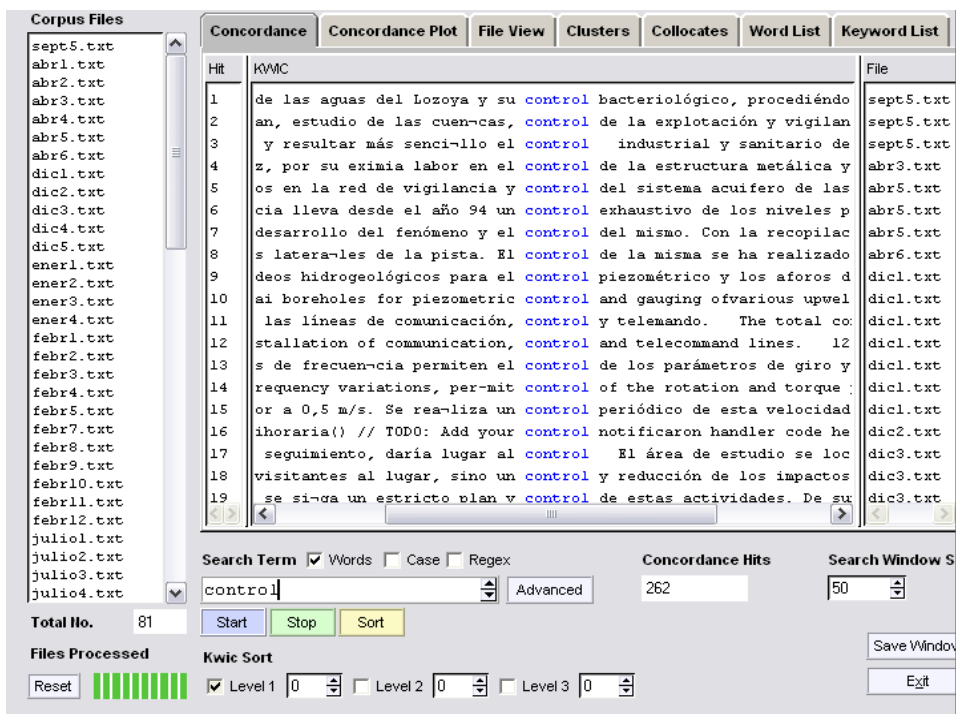


Figure 2. Concordances of the control token.

In blending (or conceptual integration), selective projections are made from the target and the source inputs. The links between the inputs and the resulting blend eventually create emergent innovative structure that can be interpreted through *patterns of compression or decompression* (Fauconnier and Turner 2008). The inputs consist of *mental spaces* that are conceptual containers of basic information. They are connected to *frames* which are schematic structures based on experience and related to memory and to previous

knowledge. Basically, we can find at least four connected mental spaces: *two inputs* linked by *cross-space mappings*, a *generic space*, and the resulting *blend* that contains *emergent structure* different from the generic space and the inputs. A series of operations may be involved, such as *composition*, i.e. a selection from the inputs to the blended space; *completion*, i.e. completing the scenario with previous or background information; and *elaboration*, i.e. creating structure (emerging) not predictable by the inputs. The cross-space mappings connect matches and counterparts in the inputs. One overriding aspect about blending is that it is a dynamic process, since novel mappings are constantly emerging. Consequently, it is like any work in construction, unfinished and ongoing. And it is through cognitive patterns such as *compression* and *decompression* that information is processed and put in use. Human beings use frames, background knowledge, long or short-term memories of scenarios, situations and experience that can be activated and updated when necessary (Schank and Abelson 1977). Engineers acquire specific knowledge suited to their practice and their corresponding mental spaces. The latter are made up of particular frames that when connected with other spaces may result in integration packets or networks that may deliver emergent structure. For example, the “engineering respecting the environment” frame and the “engineering taking care of people” frame, which will be discussed in section 3, are quite recent in engineering. Therefore, their corresponding emergent structure is nowadays being very productive. On the other hand, from the complex interrelations of blending networks and vital relations, there will be compressions, decompressions operating in the emergent structure. The networks may show links between the inputs, which according to Fauconnier and Turner (2002: 92-93) correspond to “outer-space links”, and inside the blend accounting for “inner-space links”. For example, figure 3 includes cross-space mappings linking the borrowed therapeutic roles and frames of doctors, diseases, symptoms, diagnoses, cures, and treatments applied to the engineering roles and frames about bridges with faulty behaviour affected by structural problems.

In this example the bridge could be affected by structural *fatigue* in its metallic beams or trusses. We find a generic space that is shared, i.e. the existence of a problem and the need to solve it by the pragmatic and empiric approach shared in the medical and the engineering mental spaces. However, since they refer to two different scenarios, i.e. a surgery or hospital vs. the specific location of the bridge, there are contrasting roles and dissimilar symptoms; hence a new emergent structure is created in the resulting blend. The therapeutic domain acts as a sort of scaffolding to prop ad hoc structure required in the engineering domain. The recruited repertoire is not arbitrary, but precise. It fits into a specific pattern, covering certain engineering aspects, as *fatigue* or *stress* and *rehabilitation* is the suggested treatment. This means that the input is coherent at the human scale (medical) and provides coherence to the other input (engineering), so that the former has been compressed when projected into the blend. Equally in the blend, the symptoms (*fatigue*, *stress*) have to be decompressed by the physician-engineer, since the cause of the illness-problem is compressed in the specific symptoms. Inferences result, due to the interacting links in

the inner spaces of the blend, delivering solutions for the bridge such as its *rehabilitation*. This also includes the environment where the bridge is situated. So, in the final blend we find the following conceptual relations: cause-effect (because of the intervening action), change (from initial state A to final outcome B, identity (roles doctor-engineer) as well as part/whole relation links (only some elements are highlighted: e.g. the *fatigue* problem). These elements are compressed either by scaling (the structure condition can be better or worse) or by syncopation (only some moments in the process affecting the structure are relevant enough to be activated in the blend, e.g. its lack of strength).

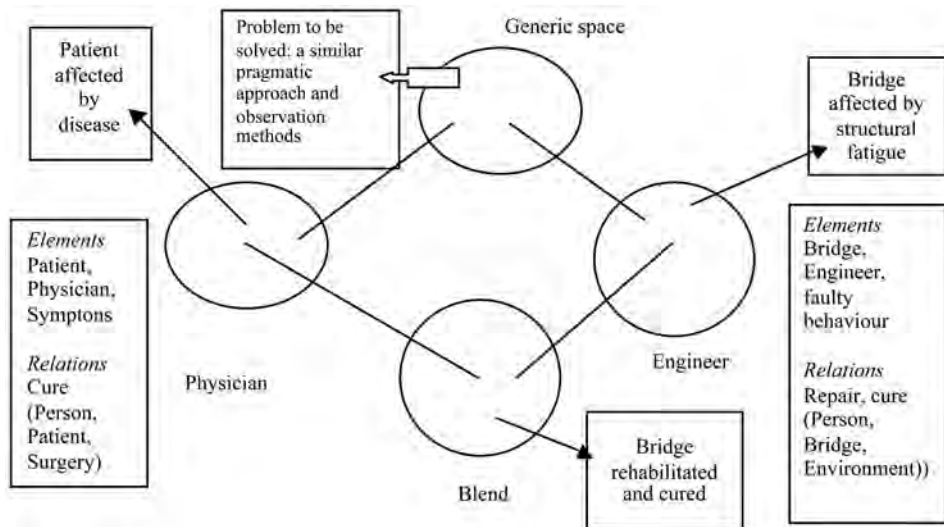


Figure 3. *Bridge rehabilitation blend.*

Furthermore, there may be two alternatives in the condition of a bridge with structural problems. One is the current faulty condition and the other the desired counterfactual state which the engineer wishes the bridge to achieve when repaired. For example, when experiencing a settling problem because of a poor subsoil, the foundations must be reinforced. In one blend the structure is unstable and weak. In the second case, the engineer solves the instability problems. In addition, engineers work with probabilistic methods and calculations, and therefore there is a lot of uncertainty in engineering decisions. In the blend that was analysed above, the consideration of playing the medical role to attend a patient (the structure) is only evoked, but not explicitly made because the blend forms part of the engineer's expert training, acquired during their whole training process.

3. ENGINEERS' BLENDS AND NETWORKS

In Fauconnier and Turner (2002), various types of networks are presented, for example, single-scope networks with connections linking input spaces with two different organizing frames and one of them “is projected to organize the blend” (2002: 126). The analogy comes from a cross-space mapping that maps competitive fights between chief executive officers (CEO) and fights in boxing. The example consists of a scenario where one opponent “defeats”, “knock outs” the other, which conveys inferences between fighting-struggle and business. According to Fauconnier and Turner, despite differences and asymmetries in the topology of both mappings, the resulting network provides insight into economic rivalry. By transferring this point into our discussion, the two input spaces are the medical and the engineering, the latter borrowing from the former and giving out the emergent mapping of problems/symptoms such as:

- *bleeding*
- *stress/strain*
- *fatigue*
- *collapse*

The resulting blend has inherited structure from the medical input and inherently includes the overarching metaphor of STRUCTURES ARE HUMAN BEINGS, which facilitates establishing links between both inputs. However, the two main agents in this network, i.e. doctors and the engineers have different organizing frames and are not identical. Engineers are not exactly counterparts of doctors but rather of what they do: i.e. solving problems. In one case they look after big structures and in the other they take care of patients. However, as figures 4 and 5 show, there are multiple spaces and complex conceptual integration networks interacting in engineering. An engineer bears in mind numerous spaces and frames; some of them may limit the scope of their projects and act as constraints in the construction process. Some of these spaces are:

- That of the materials to use or previously used
- That of aesthetics
- That of building, local and urban regulations
- That of mathematical calculations
- That of geological conditions
- That of environmental laws
- That of budget
- That of security for people
- That of the team of people to work with
- That of the culture and language where the structure will be located

Likewise, during the working process, engineers should consider the environmental effects of their work and also the impact of the structure on human life and the outside world. In this respect, among the mental spaces activated when designing a bridge, the main conceptual relations are *time*, *cause-effect*, *intentionality*,

change, identity, and representation. Time relation exists in the sense that building or repairing a structure takes time. There is also *cause and effect* from the initial state A to the final product B, as well as the *intentionality* to do so. It also includes a qualitative and quantitative *change* from the first condition to the end-result, through a series of successive stages in between. Finally, there is what the structure represents (*representation*). Therefore, when conceiving of a structure, one major factor that the engineer has to predict is the effect that the structure will have on people. As seen above in the engineer as a doctor blend, the emergent structure compressed in the blend entails the overarching metaphor of the structure being human, and hence it requires monitoring.

4. IMAGE AND PERCEPTION IN ENGINEERING

Blockley (2005: vii) claims that the different stages in the design of an engineering structure are mainly envisaged in the form of images. He claims that engineers visualise their projects in images before putting them into words. The professional builds up a visual representation of the entire process right from the beginning of a project. For example, figure 4 shows typical representations of a cable-stayed bridge (a) and of a suspension bridge (b) as well as their forces distribution. To explain technicalities and structural principles concerning these bridges engineers prefer to use images like these rather than using words or words alone. A Spanish engineer could thus communicate with a German engineer without needing to speak each other's languages.

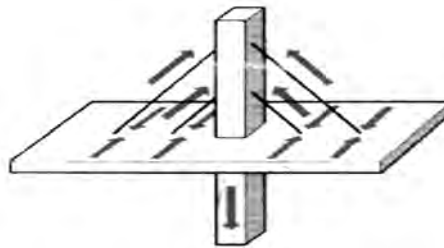


Figure 4 (a). Cable-stayed bridge representation.

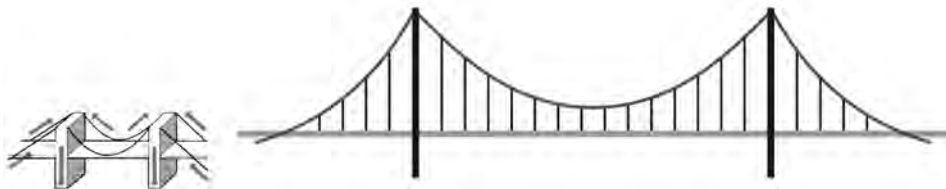


Figure 4.(b). Suspension bridge representation.

As indicated in previous research (Caballero 2003a, 2003b; Roldán and Úbeda 2006), there are a significant number of terms in architecture and engineering construction that evoke a visual origin and description. To portray their designs and creations, engineers and architects prefer to use drawings and figures that therefore activate visual interpretation in the spectator. Hence, when having to describe their work in words, they choose pictographic ones, like *the jagged fan of five overscaled concrete fins* (Caballero 2003b: 150). On a BBC interview, Santiago Calatrava, a well-known civil architect and civil engineer, explains the importance of images in his work:

You see indeed, I draw very much, constantly, among other things because in the communication you see a drawing or you see or a sign is more important than one thousand words so... Drawing is the laboratory of my ideas, their first expression. My hand motions speak even before my mouth is aware of them.

One of the hardest skills that engineers are expected to acquire is verbalising, i.e. putting into spoken and written words their mental images, this probably explains why metaphor or metonymy are so common. Caballero (2003a, 2003b), looking at the occurrence of conceptual metaphor and, particularly of image metaphor in architecture, finds that many of the examples that she presents from her collected corpus have a visual nature. Equally, she points out that it is not often easy to differentiate conceptual from image metaphor in architecture texts, claiming that there is often interplay between both types because of “the visual and aesthetic constraints of the discipline” (Caballero 2003b: 150). Adding to that, we underline the key role of visual elements in engineering, as well as their aesthetic value, which is frequently underestimated (Manterola 2010). In fact, this issue can be proved in numerous historic examples, such as the grandeur of Segovia Aqueduct or the Chinese wall. In Roldán and Úbeda (2006: 538), additional evidence indicates a considerable use of metonymic images in the description of engineering constructions. Embodiment seemingly co-occurs in engineers and architects’ conceptual mappings and, as we will show in the examples below, in image blending. Quoting Calatrava again:

It means you see that in your body almost everything is architecture, so indeed you see if you put your hands together you see, or your face you see the expression of your mouth, you see even your, the proportions of your body, all those things you see have an architecture, let’s say are patterns of understanding of architecture [Sic].

In the 15th century, Leonardo da Vinci based many of his inventions and engineering designs on the study of nature and on the proportions of the human body. This is manifested in his famous drawing of Vitruvian man. The drawing is inspired by the Roman architect Vitruvius who considered that the geometry and proportions of the human figure should be used as mathematical models for constructing buildings and temples. This way of reasoning is therefore not new and could substantiate the

occurrence of the anthropomorphic metaphor in engineering mappings and blends, as discussed above. The medical analogy may arise from considering built structures as temporary. Anthropomorphic blends may operate in images, as shown in figure 5, that depicts the “moving” shape of a human body in Calatrava’s design of the “Turning Torso”, a high-rise building in Malmö (Sweden).



Figure 5. *Turning Torso building (Malmö in Sweden) and its analogy with the human body.*

Inspired by human body movements and drawing from his knowledge as an architect and engineer, Calatrava was able to design this building. In its design, he managed to fuse the “anthropology” of the building (aesthetic aspect) with the engineering structural principles that make it habitable. In the earliest stages of planning a building, the engineer needs to draw sketches, plot computer models and solve calculations. Aspects such as the direction that the building faces, the required materials, the choice of windows and glazing and the interaction with the local climate would be considered and optimised. Most of these jobs are mainly done by means of images or models. In figure 6 we can see a picture showing three engineers simulating the load distribution principles of the bridge that two of them had designed. The bridge is Forth Rail Bridge (Scotland-UK) built in 1887. The picture shows the weight of the central span of the bridge transmitted to the river banks through diamond shaped supports. The central “weight” is Kaichi Watanabe, a Japanese engineer; Sir John Fowler and Sir Benjamin Baker, the bridge designers, provide the supports. Above them, there is a diagram of the bridge.

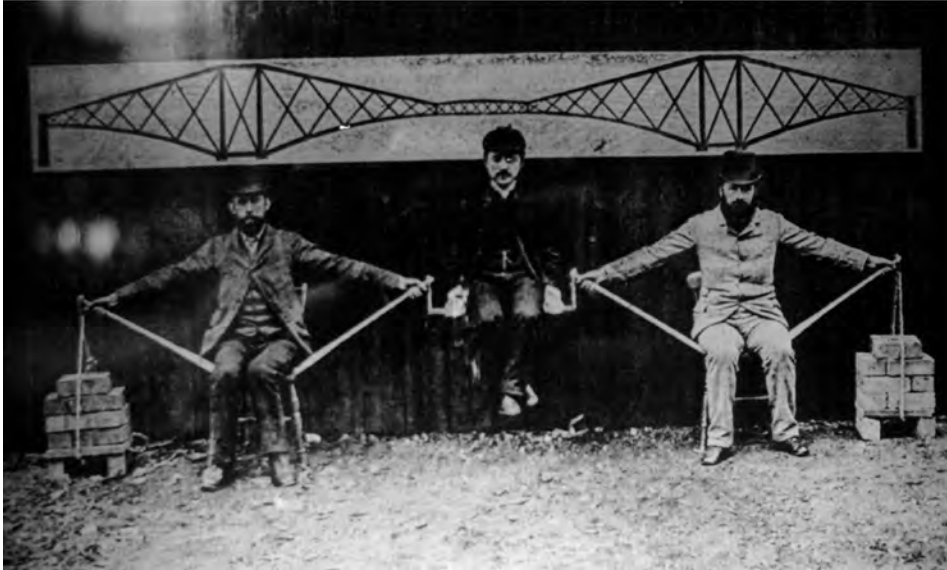


Figure 6. *Simulation of load distribution in the Firth of Forth Bridge (Scotland-UK).*

5. IMAGE BLENDING: REPRESENTATION AND INTERPRETATION

Additionally, the bridge designer may attempt to represent superimposed images in the actual shape of the bridge. In such a case, it is not only the practical utility of the bridge what counts, but its iconic representation. Calatrava has stated that he designates and elaborates his works as *artefacts* and *sculptures*. Taking as an example Alamillo Bridge (figure 7), that was designed as a portico to Seville 1992 world exhibition. This striking cable-stayed bridge has been locally associated with a harp, a fan or a swan sailing across Guadalquivir River. Therefore, the iconic interpretation of the bridge is related to conceptual relations of representation, analogy and intentionality.



Figure 7. *Alamillo Bridge in Seville (Spain).*

There is an entire set of conceptual relations that can take us back to the moment when there was no bridge, only blocks of concrete. We can see this development like an evolution, i.e. how separate blocks of concrete have shaped a unique structure, also providing a public service. Let us consider the different relations involved in the process:

- Change: transformation from one state to the final product.
- Cause-effect: the size changes, the structure is created as such, so there is a compression implied.
- Identity: it is the same concrete, but now with a different shape (compressed with time that gives out uniqueness in the end).
- Time: connected to the cause-effect and change relations.
- Part-whole: the concrete blocks are transformed into a bridge (cause- effect). In the blend, they are fused.
- Space: the concrete was transported to its final place across the river.
- Role: related to its value. The role of the bridge was the gateway to Seville 1992 exhibition, i.e. like a symbol of the city.
- Representation: the thing represented. In this case Alamillo Bridge, not the Golden Gate Bridge (or any other).
- Analogy/Similarity: A harp, or a fan. This includes the compression of the aesthetic effect (cause-effect and role-value).

- Category: started as an analogy and becomes compressed into a category relation: it is a fan. The Malmo building is a torso.
- Property: A safe bridge that causes you to feel safe when crossing it.
- Intentionality: The designer desired and sought the effect of creating a city symbol.

From all the possible conceptual relations, let us analyse the relations of analogy/similarity, of role-value and cause-effect in this case study. The local analogy about the shape of the bridge resembling a swan gives out the resulting compression of the bridge being an aquatic bird, projected from the inputs. This activates the aesthetic blend of the beauty/elegance of a swan, which metonymically accounts for the beauty/smartness of the bridge. The mapping in the blend is iconic because the shape (swan) reflects the meaning (the bridge). It also reflects the assumed intentionality of its design to turn the bridge form into a symbol (role-value). In the case of the representation of the bridge as a harp, the compression would be the musical sound of moving water. The interpretation of the bridge as a fan affords local and folkloric elements associated with the word exhibition host city (Seville) which are added to the compression (cause-effect). Built structures would then be open to interpretations, not necessarily matching the way the designer intends them to be interpreted. Calatrava has stated that he envisages this bridge as a dialogue between the deck and the pylon sustaining it.

If we consider another bridge situated in Athens (Greece), the Katchaki Bridge (figure 8), conceived by Calatrava with the shape of an ancient Greek vessel, the iconic representation describes a different scenario.



Figure 8. *Katchaki Bridge Athens (Greece).*

The image blends the bridge and Athens as well as the singularity of a vessel that transports people over an avenue, since it is a pedestrian bridge. On the other hand, it depicts an ancient Athenian Greek vessel, thus conveying a metonymic compression. According to Calatrava: “If the bridge is really successful, we can identify the place, and sometimes even the city itself, by means of it, as in the case of the Golden Gate Bridge in San Francisco, for example” [Sic].

As discussed above, when communicating engineers operate with multiple spaces and blends and among these the therapeutic/medical one is an important and productive one. Such blends are automatically used and activated through background knowledge. The engineer makes use of what Fauconnier and Turner (2002: 84) call *global insights*. This phenomenon can be transferred to other scenarios, for example, sports. The success of the game will depend from the level of knowledge and expertise of the player. Similarly, an engineer should be prepared to anticipate possible troublesome situations. This leads to “expert performance” and to the application of global insights, where, for instance, the progression cause-effect should be mastered.

6. CONCLUSIONS

This paper has explored examples of how meaning and metaphor are constructed in engineering and how conceptual metaphoric mappings and conceptual blending operate in this domain. In linguistic metaphor, counterfactuals, analogies, disanalogies and other conceptual relations operate by a set of mappings between elements from different domains. Starting from the overarching metaphor STRUCTURES ARE HUMAN BEINGS, a considerable amount of engineering expressions make use of the health and therapeutic domains acting as source domains. This may arise from the *embodiment* tradition and from conceptualizing built structures as fragile and temporary. Despite asymmetries in domains and contrasting frames, elements and roles, the cross mappings linking engineering elements with the medical domain generate a significantly productive structure.

Furthermore, a key feature in engineering communication is the widespread use of images (sketches, drawings, diagrams, graphs, etc.). Given that the representation and interpretation of images are common practice in engineering structures, the occurrence of visual metaphor is pervading. In this respect, this paper has intended to show different modes and ways through which metaphor appears as part of engineering communication.

NOTES

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